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A new *Orthosia* Ochsenheimer, 1816 species from Iran (Lepidoptera, Noctuidae, Hadeninae)

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Abstract. A new *Orthosia* species, *O. habeleri* **sp. nov.**, is described from Iran (Kerman, SE Zagros Mts), and compared with the allopatric, closely related species, *O. manfredi* Hreblay, 1994. The subgenus *Orthosia* and its three main lineages are characterised; the primary types of the taxa described by Staudinger and Hreblay & Plante are illustrated; the photographs of the male genitalia of the holotypes of *O. manfredi* Hreblay, 1994, *O. ariuna* Hreblay, 1991, *O. faqiri* Hreblay & Plante, 1994 and *O. feda* Hreblay & Plante, 1994, and the lectotype of *O. incerta* var. *pallida* Staudinger, 1888 are illustrated for the first time.

Introduction

The genus *Orthosia* Ochsenheimer, 1816 is a large Holarctic-Oriental group of the tribe Orthosiini (Noctuidae, Hadeninae), comprising more than sixty species, and the majority of them occurring in eastern and south-eastern Asia. Five species of the genus *Orthosia* (s.l.) are currently known from Iran: *O. cruda* ([Denis & Schiffermüller], 1775), *O. gracilis* ([Denis & Schiffermüller], 1775), *O. imitabilis* Hreblay, 1993, *O. incerta* (Hufnagel, 1766) and *O. sordescens* Hreblay, 1993. The subgeneric taxa accepted in the most recent literature (Ronkay et al. 2001; Ronkay et al. 2010; Volynkin and Titov 2014, etc.) are of a provisional nature before the complete revision of the Holarctic-Oriental generic group (and the whole tribe) is completed. The above-mentioned works consider most of the formerly described supraspecific taxa as subgenera within *Orthosia* (s. l.), opposing the concepts of Berio (1980) and Beck (1996, 1999a, 1999b). The subgenus *Orthosia* sensu Ronkay et al. (2010) includes altogether three species-groups mentioned below in the Synopsis and an integrative revision of the *Orthosia* generic complex may distinguish all these three species-groups to be at the subgeneric level.

The tribe Orthosiini, and within it the genus *Orthosia*, is conspicuously heterogeneous in external and genital morphology throughout the Palaearctic and Oriental regions. The great majority of the genera and species of the tribe occur in the Himalayan region, more precisely, in the Himalayan-Sino-Pacific region, which includes the main chains of the Himalaya from Pakistan to northern Indochina and the eastern frontier of the Tibetan Plateau, together with the western and central Chinese mountainous regions, Taiwan and the southern parts of Japan and continental Pacific areas (see Sugi 1955, 1986; Poole 1989; Chang 1991; Chen 1999; Hreblay and Ronkay 1997; Kononen-

ko et al. 1998; Hreblay et al. 1999; Ronkay and Ronkay 2000, 2002; Titov et al. 2017). It is worth noting that certain areas of Eurasia, especially the western Mediterranean and the arid Central Asian territories, are conspicuously poor in Orthosiini species (Ronkay et al. 2001).

The bulk of the taxa belonging to *Orthosia* were recently described (Hreblay 1991, 1993, 1994; Yoshimoto 1993; Hreblay and Plante 1994; Hreblay and Ronkay 1998, 1999; Ronkay et al. 2010; Saldaitis et al. 2011, etc.). The subgenus *Orthosia* includes 11 described species (see Ronkay et al. 2001; Volynkin and Titov 2014), only two of which occur in Europe and NW Africa while the majority of the species are Central Asiatic, inhabiting steppe-like habitats and rather dry higher montane biotopes. This habitat preference is not common in the genus *Orthosia*; most prefer more humid and most often woody biotopes.

In the first decade of the 21st century, two specimens of a curious species of Orthosiini were collected in the Kerman area of the southern Zaghros Mts and later examined independently by the authors. These specimens resemble externally mostly certain western Himalayan species of the noctuid genus *Harutaeographa* Yoshimoto, 1993, especially the dark examples of *H. bidui* Hreblay & Plante, 1996, *H. rama* Hreblay & Plante, 1996 and *H. brahma* Hreblay & Ronkay, 1998 (see Figs 19–24), except that the pectination of the male antenna of the Iranian species is quite different from those of the three *Harutaeographa* taxa. The study of the genitalia revealed, rather surprisingly, that these moths represent an unknown member of the *Orthosia incerta* species-group, displaying most of the apomorphic male genital features of this lineage, but with easily recognisable specific differences. The male genitalia of the subgenus *Orthosia* differ conspicuously from those of *Harutaeographa* in the configuration of the aedeagus and the vesica (see Figs 25–42). The new species is described below, in comparison with its closest relatives.

Material and methods

Morphology and material

Our study is based on the examination of a large set of material of the taxa belonging to the subgenus *Orthosia*, including the type-specimens of all but one species. The external and genitalic features of *O. ronkayorum* Volynkin & Titov, 2014 were evaluated from the text and illustrations of the original description. The material was set and dried in a conventional way. Genitalia preparations followed standard techniques for Noctuoidea, including the eversion of the vesica.

Photographic documentation

Representative material of the taxa of the subgenus *Orthosia* was studied and photographed. The type material was examined in the Hungarian Natural History Museum (HNHM, Budapest), the Museum für Naturkunde - Leibniz Institute for Evolution and Biodiversity Science (MfN, Berlin), and the Natural History Museum (NHMUK, London), and the private collections of Márton Hreblay and Gábor Ronkay (Budapest). The habitus of the specimens was photographed with a Nikon D90 camera; the images of the genitalia slides were taken with a Nikon Eclipse 80i photomicroscope with a Nikon DS-Fi2 digital camera. All images published in this article are preserved in the photographic catalogue of the Heterocera Research Team, Budapest.

The genitalia of the three groups in the subgenus *Orthosia* are rather well illustrated, see for instance the works of Sugi (1955, 1986); Ronkay et al. (2010); Volynkin and Titov (2014), etc. The

genitalia of the holotype specimens of the taxa described by M. Hreblay had been illustrated so far, however, only as line drawings. The photos of these genitalia structures, together with those of the lectotype of *O. incerta* var. *pallida*, are illustrated in Figs 29–38.

Abbreviations:

aed	aedeagus.
AS	Genitalia slide made by Asghar Shirvani.
ca	clasping apparatus.
HM	Genitalia slide made by Márton Hreblay.
HNHM	Hungarian Natural History Museum, Budapest, Hungary.
HT	Holotype.
LT	Lectotype.
MfN	Museum für Naturkunde - Leibniz Institute for Evolution and Biodiversity Science, Berlin, Germany.
NHMUK	The Natural History Museum (formerly British Museum, Natural History or BMNH), London, Great Britain.
PT	Paratype.
RL	Genitalia slide made by László Ronkay.
TLMF	Tiroler Landesmuseum Ferdinandeum, Innsbruck, Austria.

Results and discussion

Synopsis

Subgenus *Orthosia* Ochsenheimer, 1816

Orthosia Ochsenheimer, 1816, "Die Schmetterlinge von Europa" **4**: 79. Type-species: *Noctua instabilis* [Denis & Schiffermüller], 1775 (= *Phalaena incerta* Hufnagel, 1766), by subsequent designation by Curtis, 1828.

List of species

***incerta*-group**
incerta (Hufnagel, 1766) (Figs 27, 28)
ssp. *incognita* Sugi, 1955 (Fig. 4)
manfredi Hreblay, 1994 (Figs 5, 6, 29, 30)
habeleri **sp. nov.** (Figs 1–3, 25, 26)

***picata*-group**
picata Bang-Haas, 1912 (= *pallida* Staudinger, 1888, praeocc. (Figs 7, 8, 31, 32)
ariuna Hreblay, 1991 (Figs 17, 18, 33, 34)
ronkayorum Volynkin & Titov, 2014
reshoefti Hreblay, 1994 (Figs 15, 16)
faqiri Hreblay & Plante, 1994 (Figs 9, 10, 35, 36)
feda Hreblay & Plante, 1994 (Figs 11–14, 37, 38)

***evanida*-group**
evanida (Butler, 1879)
perfusca Sugi, 1986
ssp. *pekarskyi* Ronkay, Ronkay, Gyulai & Hacker, 2010
aoyamensis (Matsumura, 1926)

Systematic part

The first really detailed description of the major lineages of *Orthosia* s. l. was published in Italian by Berio (1985). A general characterisation of the subgenus *Orthosia* Ochsenheimer, 1816 was first provided in English by Hreblay and Plante (1994), subsequently by Ronkay et al. (2001); only a brief summary of the main group features is presented here.

The subgenus *Orthosia* comprises medium-sized or rather large species (wingspan 30–45 mm), with elongated, relatively narrow, apically pointed forewings; forewing pattern can be variously expressed, often blurred, or rather sharply marked, with distinct crosslines and orbicular and reniform stigmata; colouration very variable; the individual variation is remarkable in all known species. The most typical external morphological feature of the subgenus is the biserrate male antenna (with long, fasciculate cilia), its pectination is shorter than in the other major groups of *Orthosia*. It is worth to mention that the female antenna is not filiform as in most other groups of *Orthosia* s.l. but, minutely or shortly, biserrate, with long sparse fasciculate cilia.

The male genitalia of the subgenus *Orthosia* are characterised by the following group features: 1) male genital capsule strongly sclerotized, symmetrical; 2) uncus usually scaphoidal; 3) juxta strong, narrow and long, quadrangular; 4) vinculum strong, very long, V-shaped; 5) valva elongate with most often characteristically S-shaped costal margin; 6) cucullus small or medium-sized, acutely triangular (except in *O. habeleri* and *O. perfusca*), most often with strong, cuneate pollex (reduced only in *O. manfredi*, *O. habeleri* and *O. perfusca*; 7) corona absent; 8) sacculus long, distal end heavily sclerotized; 9) clavus usually large, lobate, rounded; 10) ampulla strong, falcate or arched thorn-like; 11) harpe with short, digitiform or pyriform (erected) process; 12) aedeagus long, cylindrical, carina with long, heavily sclerotized, acute ventral (or subventral) thorn and short, straight ventro-lateral bar; 13) vesica broadly tubular, membranous, recurved ventro-laterally, with subconical medial diverticulum.

The diagnostic features of the female genitalia are as follows: 1) ovipositor relatively long, conical, apophyses posteriores long, slender; 2) antrum narrowly lyriform or calyculate, heavily sclerotized, often with serrate-dentate lateral crests; 3) ductus bursae long, tubular, variably thick, most often dilated distally; 4) appendix bursae membranous, helicoid; 5) corpus bursae ellipsoidal-ovoid, with four long signum-stripes; 6) last sternite with narrow, long, sclerotized bars.

The subgenus *Orthosia* is a rather compact species group consisting of three main lineages, the *O. incerta*-, the *O. picata*-, and the *O. evanida*-lineages. This subgenus is still a challenging complex from a taxonomic point of view, containing externally often confusingly similar species, while the genitalia of both sexes display clearly recognisable distinctive features. The genitalia of both sexes do not show distinctive variation within a species, despite the great individual variation in the external features; even the Trans-Palaearctic *O.* (*O.*) *incerta* has actually only one recognised subspecies, the Japanese ssp. *incognita*.

The members of the *O. incerta*-lineage differ externally from those of the *O. picata*-lineage mainly in their larger size, sometimes also by their the more blurred forewing pattern while the genitalia show differences in the general features, e.g. the shape of the uncus, the configuration of the distal part of the valva, the length of the pollex and the thorn of the carina (males), the shape of the sclerotization of the antrum and the shape and thickness of ductus bursae (females). The members of the *O. evanida*-lineage are externally rather similar due to their rather large size, broad forewings with distinct antemedial, postmedial and subterminal lines and well-marked, large orbicular and reniform stigmata. This lineage appears more heterogeneous, however, by the configuration of their male genitalia (see Ronkay et al. 2010), especially the valval shapes of the three known species appear as strikingly different from each other while the features of the aedeagus and the vesica clearly demonstrate their close relationship.

Orthosia (*Orthosia*) *habeleri* sp. nov.

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Figs 1–3, 25, 26

Type material. ***Holotype***. Male, Iran, Kerman, Kuh-e-Hessar/Abshar, 2820 m, 29°33'N, 57°18'E, 28.iv.2006, leg. B. Plössl & G. Tarmann; slide No. N1595 (coll. TLMF, Hall in Tyrol).

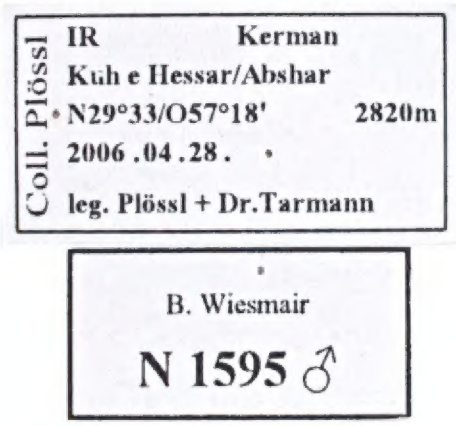
Paratype. Male, Iran, Kerman, Jiroft, Mardehak, 2273 m, v.2009, leg. M. Shoghali; slide No. AS532 (coll. Shahid Bahonar University, Kerman).

Taxonomy. The new species belongs to the *incerta*-lineage, its closest known relative is the Moroccan *O. manfredi*, due to the progressive series of similar morphological reductions in the male genitalia (reduction of the pollex, and the shortened carinal thorn or the rather straight aedeagus). On the other hand, there are a number of easily recognisable specific external and male genital features which distinguish the three closely related species, *O. habeleri*, *O. manfredi* and *O. incerta*.

Diagnosis. The male genitalia of the new species (Figs 25, 26) can be distinguished from those of *O. incerta* and *O. manfredi* (Figs 27–30) by the 1) subapically stronger dilated, apically more tapering uncus (it is the widest medially while the broadest part is the apical section in the two close relatives); 2) the more elongated valva with distally less curved costa; 3) the larger and apically broader, rounded cucullus; 4) the basally straighter, medially less curved, rather arched thorn-like ampulla; and 5) the much stronger, longer and thicker erect part of the harpe (clasper). The rather straight aedeagus and the shortened carinal thorn of *O. habeleri* is closer to those of *O. manfredi* than to *O. incerta* but the basal part of the carinal thorn of the new species has a broader junction plate and is more divergent from the main tube of the vesica than in the other two relatives. The aedeagus of *O. incerta* is longer and more arched than in the two other sister taxa and the carinal thorn is remarkably longer than in *O. habeleri* and *O. manfredi*.

Description. Wingspan 36–37 mm (holotype: 36 mm; paratype 37 mm), length of forewing 16 mm. Ground colour of the two known specimens conspicuously different (see the Figs 1–3), varying from ochreous-brown to smoky-greyish with black irroration. Eyes large, hairy; palpi rather slender; male antennae biserrate with short fasciculate cilia. Pubescence of head, collar, tegulae and thorax unicolorous. Forewing relatively narrow, apically pointed, outer margin slightly sinuous.

01. *Orthosia habeleri* HT male Iran Kerman



02. *Orthosia habeleri* HT male Iran Kerman labels

03. *Orthosia habeleri* PT male Iran Kerman

04. *Orthosia incerta incognita* male Japan

05. *Orthosia manfredi* HT male Morocco

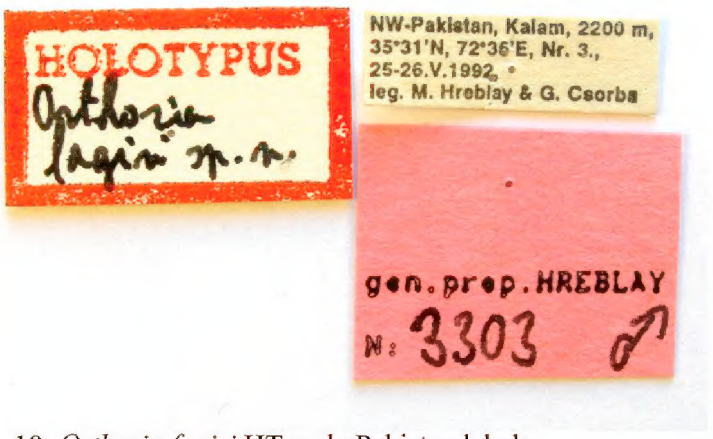
06. *Orthosia manfredi* HT male Morocco labels

07. *Orthosia picata* (*Orthosia incerta* var. *pallida*, LT) male Kuldja

08. *Orthosia picata* (*Orthosia incerta* var. *pallida*, LT) male Kuldja labels

Figures 1–8. **1** *Orthosia habeleri*, HT, male, Iran, Kerman **2** *Orthosia habeleri*, HT, male, Iran, Kerman, labels **3** *Orthosia habeleri*, PT, male, Iran, Kerman **4** *Orthosia incerta incognita*, male, Japan **5** *Orthosia manfredi*, HT, male, Morocco **6** *Orthosia manfredi*, HT, male, Morocco, labels **7** *Orthosia picata* (*Orthosia incerta* var. *pallida*, LT), male, Kuldja **8** *Orthosia picata* (*Orthosia incerta* var. *pallida*, LT), male, Kuldja, labels.

09. *Orthosia faqiri* HT male Pakistan

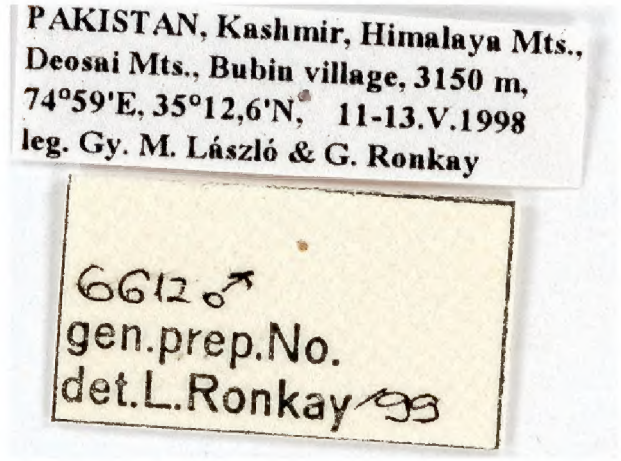


10. *Orthosia faqiri* HT male Pakistan labels

11. *Orthosia feda* HT male Pakistan

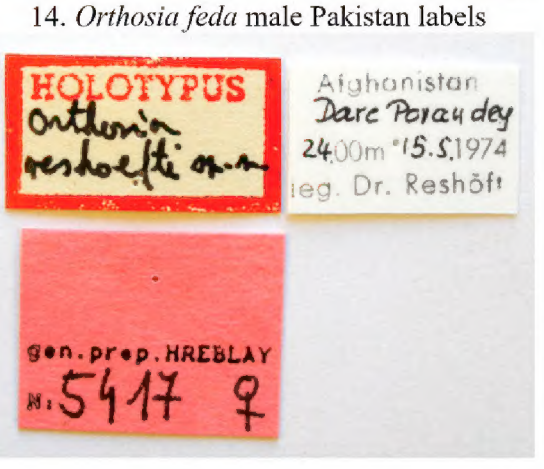
12. *Orthosia feda* HT male Pakistan labels

13. *Orthosia feda* male Pakistan



14. *Orthosia feda* male Pakistan labels

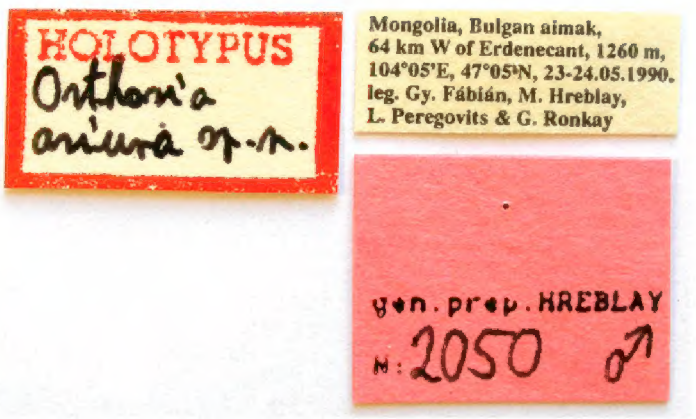
15. *Orthosia reshoefti* HT female Afghanistan



16. *Orthosia reshoefti* HT female Afghanistan

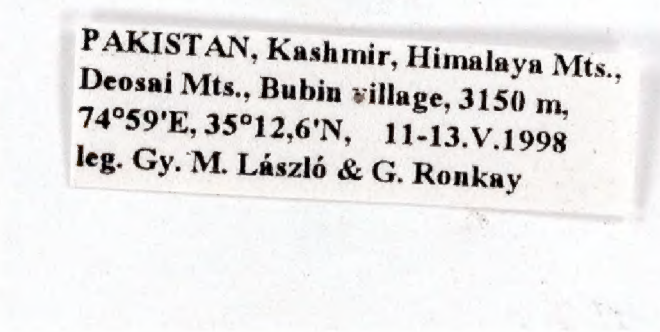
Figures 9–16. 9 *Orthosia faqiri*, HT, male, Pakistan **10** *Orthosia faqiri*, HT, male, Pakistan, labels **11** *Orthosia feda*, HT, male, Pakistan **12** *Orthosia feda*, HT, male, Pakistan, labels **13** *Orthosia feda*, male, Pakistan **14** *Orthosia feda*, male, Pakistan, labels **15** *Orthosia reshoefti*, HT, female, Afghanistan **16** *Orthosia reshoefti*, HT, female, Afghanistan, labels.

17. *Orthosia ariuna* HT male Mongolia



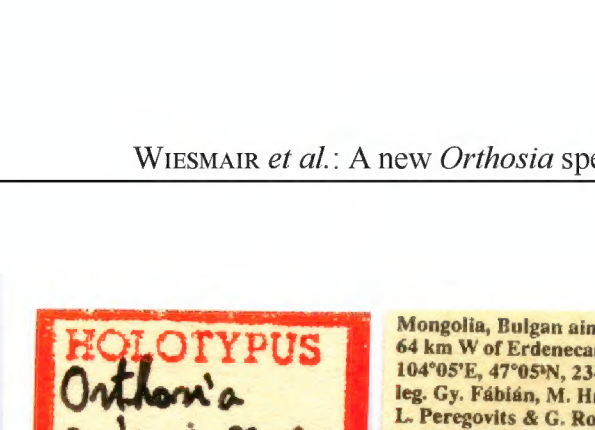
18. *Orthosia ariuna* HT male Mongolia labels

19. *Harutaeographa bidui* male Pakistan



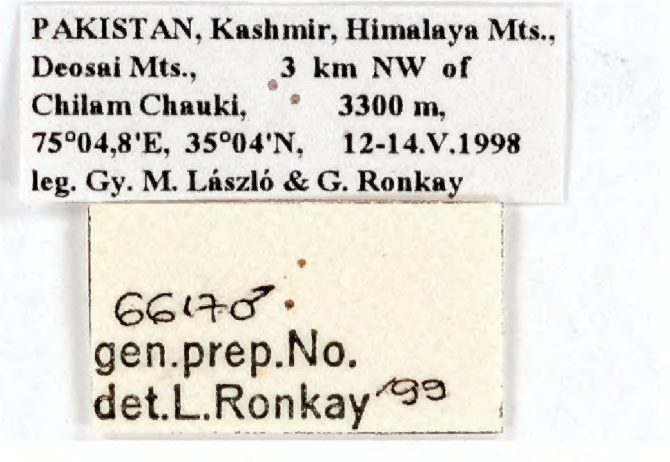
20. *Harutaeographa bidui* male Pakistan label

21. *Harutaeographa brahma* PT male Nepal



22. *Harutaeographa brahma* PT male Nepal labels

23. *Harutaeographa rama* male Pakistan



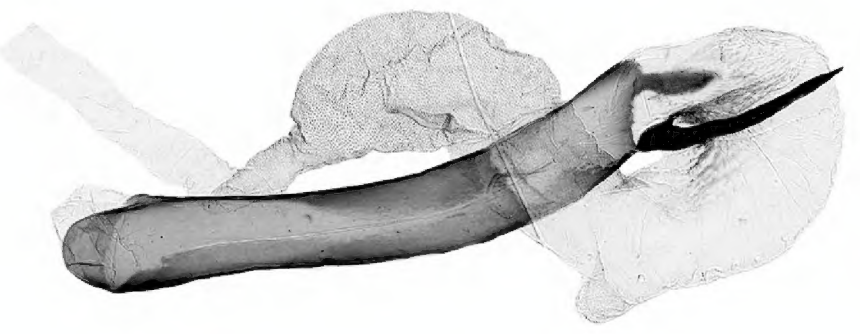
24. *Harutaeographa rama* male Pakistan labels

Figures 17–24. 17 *Orthosia ariuna*, HT, male, Mongolia **18** *Orthosia ariuna*, HT, male, Mongolia, labels **19** *Harutaeographa bidui*, male, Pakistan **20** *Harutaeographa bidui*, male, Pakistan, label **21** *Harutaeographa brahma*, PT, male, Nepal **22** *Harutaeographa brahma*, PT, male, Nepal, labels **23** *Harutaeographa rama*, male, Pakistan **24** *Harutaeographa rama*, male, Pakistan, labels.

25. N1595m_*Orthosia habeleri* HT Iran Kerman ca

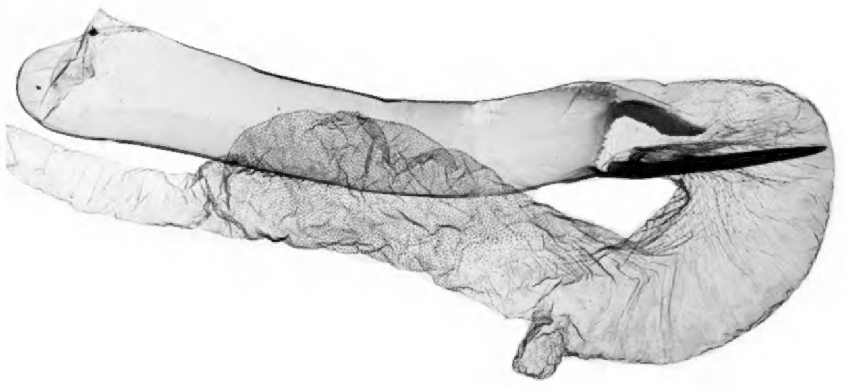
26. N1595m_*Orthosia habeleri* HT Iran Kerman aed

27. RL3195m_*Orthosia incerta* Turkey ca



28. RL3195m_*Orthosia incerta* Turkey aed

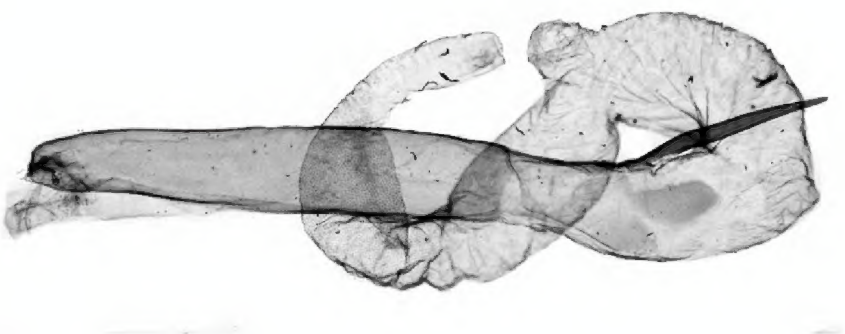
29. HM6024m_*Orthosia manfredi* HT Morocco ca



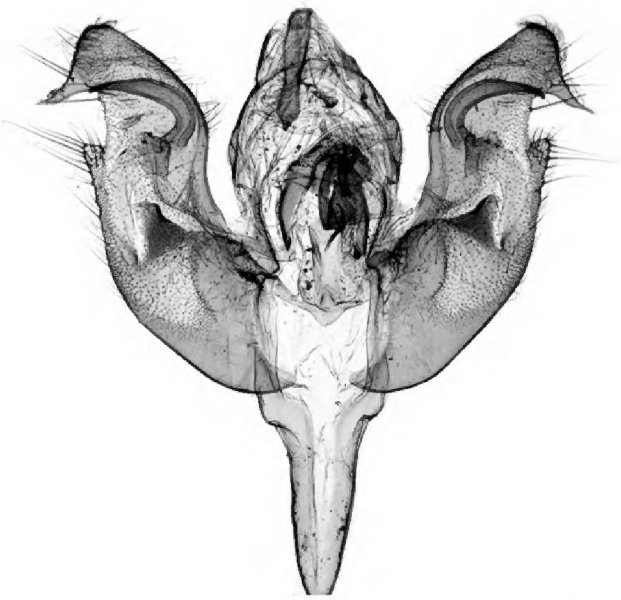
30. HM6024m_*Orthosia manfredi* HT Morocco aed

Figures 25–30. 25 N1595m, *Orthosia habeleri*, HT, Iran Kerman, ca **26** N1595m, *Orthosia habeleri*, HT, Iran, Kerman, aed **27** RL3195m, *Orthosia incerta*, Turkey, ca **28** RL3195m, *Orthosia incerta*, Turkey, aed **29** HM6024m, *Orthosia manfredi*, HT, Morocco, ca **30** HM6024m, *Orthosia manfredi*, HT, Morocco, aed.

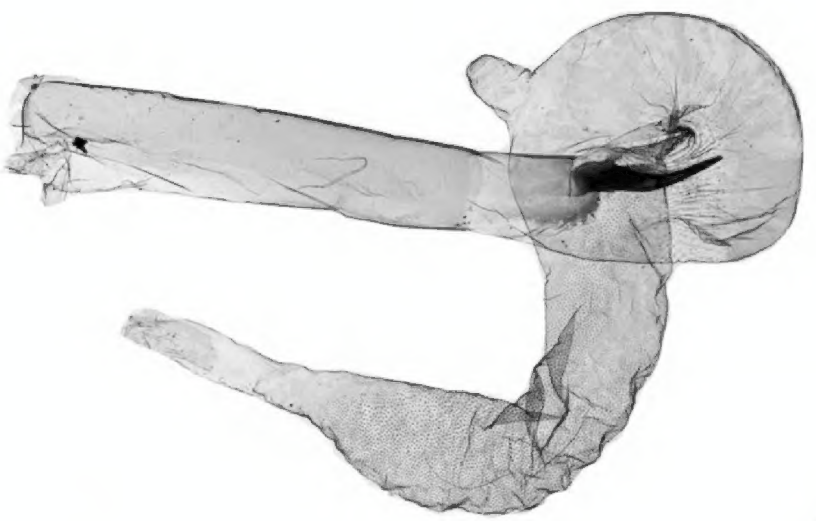
31. HM2257m_*Orthosia picata* (*Orthosia incerta* var. *pallida*, LT) Kuldja ca



32. HM2257m_*Orthosia picata* (*Orthosia incerta* var. *pallida*, LT), Kuldja aed

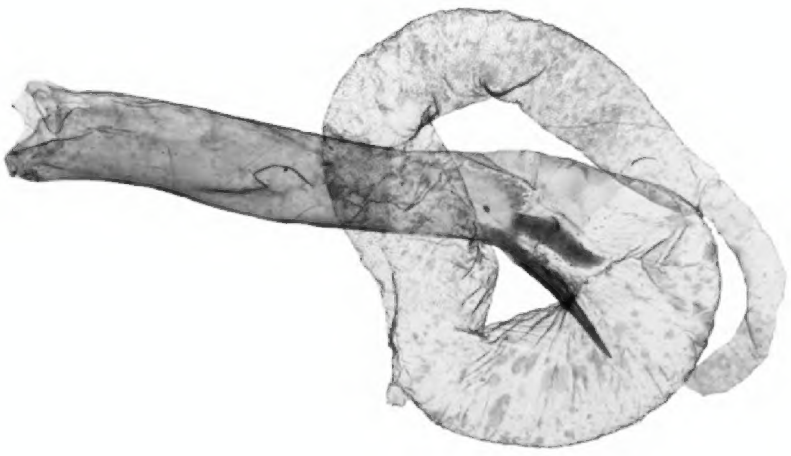


33. HM2050m_*Orthosia ariuna* HT Mongolia ca



34. HM2050m_*Orthosia ariuna* HT Mongolia aed

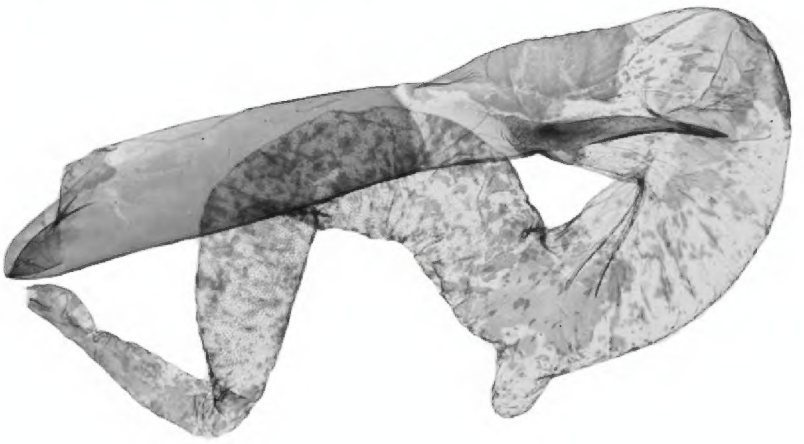
35. HM3303m_*Orthosia faqiri* HT Pakistan ca



36. HM3303m_*Orthosia faqiri* HT Pakistan aed

Figures 31–36. 31 HM2257m, *Orthosia picata* (*Orthosia incerta* var. *pallida*, LT), Kuldja, ca **32** HM2257m, *Orthosia picata* (*Orthosia incerta* var. *pallida*, LT), Kuldja, aed **33** HM2050m, *Orthosia ariuna*, HT, Mongolia, ca **34** HM2050m, *Orthosia ariuna*, HT, Mongolia, aed **35** HM3303m, *Orthosia faqiri*, HT, Pakistan, ca **36** HM3303m, *Orthosia faqiri*, HT, Pakistan, aed.

37. HM3305m_*Orthosia feda* HT Pakistan Rama ca



38. HM3305m_*Orthosia feda* HT Pakistan Rama aed

39. RL6619/6620m *Harutaeographa bidui* Pakistan ca

40. RL6619/6620m *Harutaeographa bidui* Pakistan aed

41. RL5172/5173m *Harutaeographa brahma* PT Nepal ca

42. RL5172/5173m *Harutaeographa brahma* PT Nepal aed

Figures 37–42. 37 HM3305m, *Orthosia feda*, HT, Pakistan, Rama, ca **38** HM3305m, *Orthosia feda*, HT, Pakistan, Rama, aed **39** RL6619/6620m, *Harutaeographa bidui*, Pakistan, ca **40** RL6619/6620m, *Harutaeographa bidui*, Pakistan, aed **41** RL5172/5173m, *Harutaeographa brahma*, PT, Nepal, ca **42** RL5172/5173m, *Harutaeographa brahma*, PT, Nepal, aed.

Forewing markings very variable in the two individuals, elements of noctuid pattern less distinct, basal two-thirds of costal margin paler than ground colour; basal dash present, short, black; antemedial line obsolescent; postmedial line better visible, dark blackish-grey; median area somewhat darker than ground colour. Orbicular and reniform stigmata present, their filling slightly paler than median area, their outlines rather distinct, blackish-grey; claviform stigma obsolete. Subterminal line distinct, waved, defined by dark grey scales in tornal and median areas; terminal line fine, whitish-ochreous; terminal area and fringes as ground colour, fringes finely spotted with darker scales and fine blackish medial line. Hindwings whitish-ochreous, suffused strongly with darker ochreous-brown to brownish grey; discal spot and tornal patch darker brown-grey; terminal line fine, dark grey-brown; fringe somewhat darker than ground colour; abdomen dark brown, without distinctly coloured lateral ridges and dorsal crest, basal abdominal brush organ („trifine brush organ") absent.

Male genitalia (Figs 25, 26). Genital capsule symmetrical, strongly sclerotized. Tegumen narrow and high; valvae elongated, costal margin weakly S-shaped; sacculus long, sclerotized; clavus large, rounded; harpe broad, with short, erect digitiform process; ampulla long, almost straight or somewhat arched thorn-like (right ampulla of the holotype is broken, that is complete in the paratype), its basal half wider, tapering apically; cucullus large, basally straight; pollex and corona absent. Uncus scaphoidal, basally cylindrical, subapically dilated, tapering apically; juxta long and strong, quadrangular; vinculum very long, pointed, V-shaped. Aedeagus cylindrical, long and rather straight; carina with long, sclerotized, pointed thorn. Vesica tubular, recurved, bearing a small subconical diverticulum in basal half.

Female genitalia. Unknown.

Bionomics and distribution. The species is known from the regions of high elevation of the southern Zaghros Mts (the two specimens were collected above 2200 m elevation). The biology is poorly known, but the flight period is in late spring (April–May), similar to several other species of the genus.

Etymology. The new species is dedicated to Heinz Habeler (Graz, Austria), who was the mentor providing enthusiastic help and motivation to the first author.

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References

Beck H (1996) Systematische Liste der Noctuidae Europas (Lepidoptera, Noctuidae). Neue entomologische Nachrichten 36: 1–122.

Beck H (1999a) Die Larven der Europäischen Noctuidae Revision der Systematik der Noctuidae (Lepidoptera: Noctuidae) Vol. I. Text. Herbipoliana 5(1): 1–859.

Beck H (1999b) Die Larven der Europäischen Noctuidae Revision der Systematik der Noctuidae (Lepidoptera: Noctuidae) Vol. II. Zeichnungen. Herbipoliana 5(2): 1–447.

Berio E (1980) Modificazioni al sistema delle Hadeninae e Cuculliinae Italiane attualmente seguito (Lepidoptera – Noctuidae). Annali del Museo civico di Storia Naturale Giacomo Doria 83: 1–19.

Berio E (1985) Lepidoptera. Noctuidae I. Generalitá, Hadeninae, Cuculliinae. Fauna d'Italia, vol. 22. Edizione Calderini, Bologna, 970 pp. [322 figs]

Chen XY (1999) Noctuidae. Fauna Sinica, Insecta vol. 16, Lepidoptera, Noctuidae. Science Press, Beijing, lxxiii + 1596 pp. [pls 1–68]

Chang BS (1991) Illustrations of Moths in Taiwan 5. Noctuidae. Taiwan Museum, Taipei, 366 pp.

Hacker H (1992) Neue Noctuidae-Arten aus Nordthailand. Esperiana 3: 185–191.

Hreblay M (1991) Neue Taxa aus der Gattung *Orthosia* Ochsenheimer, 1816 (s.l.) (Lepidoptera, Noctuidae). Acta Zoologica Academiae Scientiarum Hungaricae 37(3–4): 193–203.

Hreblay M (1993) Neue Taxa aus der Gattung *Orthosia* Ochsenheimer, 1816 (s.l.) II. (Lepidoptera, Noctuidae). Acta Zoologica Academiae Scientiarum Hungaricae 39(1–4): 71–90.

Hreblay M (1994) New taxa of the tribe Orthosiini, IV. (Lepidoptera, Noctuidae). Acta Zoologica Academiae Scientiarum Hungaricae 40(3): 241–252.

Hreblay M, Plante J (1994) New taxa of the genus *Orthosia* Ochsenheimer, 1816 III. (Lepidoptera, Noctuidae). Acta Zoologica Academiae Scientiarum Hungaricae 40(1): 21–27.

Hreblay M, Ronkay L (1997) New Noctuidae species from Taiwan and the adjacent areas (Lepidoptera). Acta Zoologica Academiae Scientiarum Hungaricae 43(1): 21–83.

Hreblay M, Ronkay L (1998) Noctuidae from Nepal. Moths of Nepal. Part 5. Tinea 15 (Supplement 1): 117–310.

Hreblay M, Ronkay L (1999) Neue trifide Noctuidae aus der himalayanischen Raum und der südostasiatischen Region (Lepidoptera: Noctuidae). Esperiana 7: 485–620.

Hreblay M, Peregovits L, Ronkay L (1999) New genera and species of Noctuidae from Vietnam, Thailand and Nepal (Lepidoptera). Acta Zoologica Academiae Scientiarum Hungaricae 45(1): 1–96.

Kononenko VS, Ahn SB, Ronkay L (1998) Illustrated Catalogue of Noctuidae in Korea (Lepidoptera). In: Park KT (Ed.) Insects of Korea [3], 509 pp.

Poole RW (1989) Noctuidae 1–3. In: Heppner J (Ed.) Lepidopterorum Catalogus (New Series). Leiden, New York, København, Köln. 1314 pp.

Ronkay G, Ronkay L (2000) New Noctuidae taxa from Taiwan (Lepidoptera). (Results of the joint project of the HNHM and the TFRI, entitled with "Biodiversity studies on the fauna of Taiwan, No. 1.). Bulletin of the National Museum of Natural Science, Taichung 12: 93–112.

Ronkay G, Ronkay L (2002) New Noctuidae taxa from Taiwan (Lepidoptera), ii. (Results of the joint project of the HNHM and the TFRI, entitled with "Biodiversity studies on the Macrolepidoptera fauna of Taiwan: taxonomy, faunagenetics and inventory of selected Lepidopteran families", No. 4.) Acta Zoologica Academiae Scientiarum Hungaricae 47(4): 371–398.

Ronkay G, Ronkay L, Gyulai P, Hacker H (2010) New Orthosiini (Lepidoptera, Noctuidae, Hadeninae) species and genera from the wide sense Himalayan region. Esperiana 15: 127–221. [plates 12–29]

Ronkay L, Yela JL, Hreblay M (2001) Hadeninae II. Noctuidae Europaeae, 5. Entomological Press, Sorø, 452 pp. [+ 21 colour plates]

Saldaitis A, Benedek B, Visinskiene G (2011) Description of two new species of Noctuidae from China (Lepidoptera, Noctuoidea). Zootaxa 3020: 60–68. https://doi.org/10.11646/zootaxa.3020.1.3

Sugi S (1955) A revision of the Japanese *Orthosia* (Lepidoptera, Noctuidae, Hadeninae). Tinea 2: 90–104.

Sugi S (1986) The Noctuidae of Taiwan 2. Genus *Orthosia* Ochsenheimer (Lepidoptera). Entomological papers pres. Kurosawa, Tokyo 1986: 98–105.

Titov SV, Volynkin AV, Dubatolov VV, Cernila M, Reznichenko SM, Bychkov VS (2017) Noctuoid moths (Lepidoptera: Erebidae, Nolidae, Noctuidae) of North-East Kazakhstan (Pavlodar Region). Ukrainian Journal of Ecology 7(2): 142–164. https://doi.org/10.15421/2017_32

Volynkin AV, Titov SV (2014) A new species of *Orthosia* Ochsenheimer, 1816 from North-East Kazakhstan (Lepidoptera, Noctuidae). Zootaxa 3753(5): 494–500. https://doi.org/10.11646/zootaxa.3753.5.7

Yoshimoto H (1993) Noctuidae. Moths of Nepal. Part 2. Tinea 13 (Supplement 3): 124–141.